Estimates for SOFIA Optics -- AH Oct 04 from
Estimates for the LMT optics -- A. Harris, Feb. 1996
(Ref: "Astronomical Optics," Schroeder, pp. 15-20,97-100)

$d_s := 0.352$ $d_p := 2.5$ $f_p := 1.28 \cdot d_p$ $bfd := 4.15$

$k := \frac{d_s}{d_p}$ $m(k, bfd) := \frac{1 + \frac{bfd}{f_p}}{k} - 1$ $fno := \frac{m(k, bfd) \cdot f_p}{d_p}$ $f := d_p \cdot fno$

$k = 0.141$ $m(k, bfd) = 15.313$ $fno = 19.601$ $f_p = 3.2$ $f = 49.002$

$d_{sfp}(f_p, k, bfd) := bfd + f_p \cdot (1 - k)$ secondary-focal plane dist $d_{sfp}(f_p, k, bfd) = 6.899$

$d_{spf}(f_p, k) := f_p \cdot k$ secondary-primary focus distance $d_{spf}(f_p, k) = 0.451$

$d_{spv}(f_p, k) := f_p \cdot (1 - k)$ secondary-primary vertex distance $d_{spv}(f_p, k) = 2.749$

$d_{fpe}(f_p, k, bfd) := f_p \cdot \frac{m(k, bfd)^2 \cdot k}{m(k, bfd) + k - 1}$ focal plane-exit pupil distance $d_{fpe}(f_p, k, bfd) = 7.31$

$K_2 := -\left(\frac{m(k, bfd) + 1}{m(k, bfd) - 1}\right)^2$ secondary conic constant $K_2 = -1.299$

$\varepsilon := \frac{m(k, bfd) + 1}{m(k, bfd) - 1}$ eccentricity $\varepsilon = 1.14$

$ps := m(k, bfd) \cdot f_p \cdot 10^3 \cdot 4.848 \cdot 10^{-6}$ plate scale at focus, mm/arcsec $ps = 0.238$

$ang := \frac{100}{60 \cdot ps}$ field of view in 0.1m at focus, arcmin $ang = 7.016$

$d_{ss} := \left[|k| + 2 \cdot \left(60 \cdot 4.848 \cdot 10^{-6}\right) \cdot \frac{f_p}{d_p} \cdot (1 - k) \cdot ang \right] \cdot d_p$ actual d_s with fov $d_{ss} = 0.363$

$wvl := .0005$ 0.5 mm wavelength $\frac{d_s}{d_{ss}} = 0.969$

$pixel := \frac{1.5 \cdot wvl}{d_p} \cdot \frac{1}{4.848 \cdot 10^{-6}}$ $pixel = 61.881$ pixel, arcsec

$pixsc := \frac{pixel \cdot ps}{1000}$ $pixsc = 0.015$ m/pixel $\frac{0.1 \cdot d_s}{pixsc} = 2.394$ Pixels to shift to 0.1 d_subr

Cassegrain abberation terms (from Padman 1995, p. 11):

$$C := \frac{-m(k,bfd)\cdot d_{spv}(f_p,k)}{2\cdot f\cdot d_{sfp}(f_p,k,bfd)} \qquad C = -0.062 \qquad \text{Astigmatism}$$

$$D := \frac{-m(k,bfd)^2\cdot d_{spv}(f_p,k)}{2\cdot f\cdot d_{sfp}(f_p,k,bfd)} \qquad D = -0.953 \qquad \text{Curvature}$$

$$E := 0 \qquad E = 0 \qquad \text{Distortion}$$

$$F := -\frac{1}{4\cdot f^2} \qquad F = -1.041 \times 10^{-4} \qquad \text{Coma}$$

$$rcurv := \frac{1}{2\cdot(C + D)} \qquad rcurv = -0.492 \qquad \text{Radius of curvature}$$

Solve for focal plane radii with 1/err wavelength phase error in each term

$$err := 30$$

$h := 1.$

$$errc(h) := -C\cdot\left(\frac{h}{f}\right)^2\cdot\left(\frac{d_p}{2}\right)^2 \qquad rc := root\left(\left|errc(h)\right| - \frac{wvl}{err}, h\right) \qquad rc = 0.706 \quad \text{Astigmatism radius}$$

$$\frac{rc}{pixsc} = 48.013 \quad \text{pixels}$$

$h := .3$

$$errd(h) := -\frac{D}{2}\cdot\left(\frac{h}{f}\right)^2\cdot\left(\frac{d_p}{2}\right)^2 \qquad rd := root\left(\left|errd(h)\right| - \frac{wvl}{err}, h\right) \qquad rd = 0.24 \quad \text{Curvature radius}$$

$$\frac{rd}{pixsc} = 16.297 \quad \text{pixels}$$

$h := 1$

$$errf(h) := F\cdot\frac{h}{f}\cdot\left(\frac{d_p}{2}\right)^3 \qquad rf := root\left(\left|errf(h)\right| - \frac{wvl}{err}, h\right) \qquad rf = 4.016 \quad \text{Coma radius}$$

$$\frac{rf}{pixsc} = 273.199 \quad \text{pixels}$$